

# Preventing Contamination with Double Tubeplates

**Production quality, system design and system maintenance are essential to preventing contamination.**

By Matt Hale, HRS Heat Exchangers

**P**roduct safety is crucial for any business, but when it comes to the food, beverage and pharmaceutical sectors, product safety can be a matter of life or death. Often, a key aspect is preventing contamination between products, or between process materials/chemicals and the end products. Equipment design and construction play

key roles in achieving these goals, and the heat exchangers used for processes such as pasteurization and sterilization are no exception.

Whether you are making food products or medical supplies, there are three main elements to preventing contamination in tubular heat exchangers: production quality, system design and system maintenance.

## Production Quality

As with many things in life, when it comes to process equipment, you generally get what you pay for. If a quotation for a new heat exchanger seems to be much lower than others, be sure to check the specifications, particularly the materials of construction specified. Both the quality of materials such as the use of the right quality of stainless steel as well as the quality of construction matter.

Inherently, the joint between the tube and the tubesheet (or plate) is often the weakest part of a heat exchanger. As a result, welding needs to be precise, and the joints – whether rolled or welded – need to be smooth to prevent product fouling or avoid harboring product or chemicals that can then become contaminants. Obviously, joints and

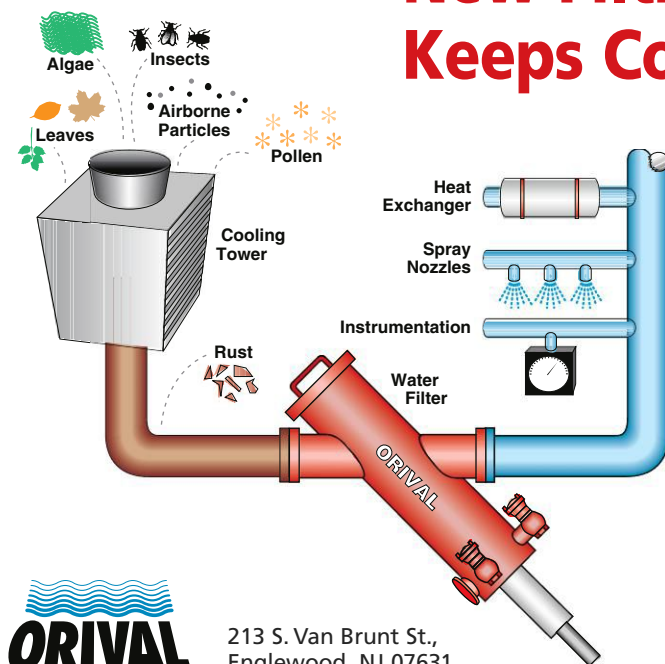
seals also have to be strong enough to not fail under pressure. Reputable manufacturers usually will allow you to see the production facilities and provide information on the fabrication processes and standards.

## System Design

The type of heat exchanger and its design capacity will determine the number of tubes that are required. At some point, the tubes will need to be supported and attached to the body of the heat exchanger – usually at the ends. This part of the heat exchanger is known as the tubesheet (sometimes as the tubeplate). The tubesheet not only supports the tubes but also provides a barrier between the product and the service fluid.

Leakage in tubular heat exchangers often leads to cross contamination between the

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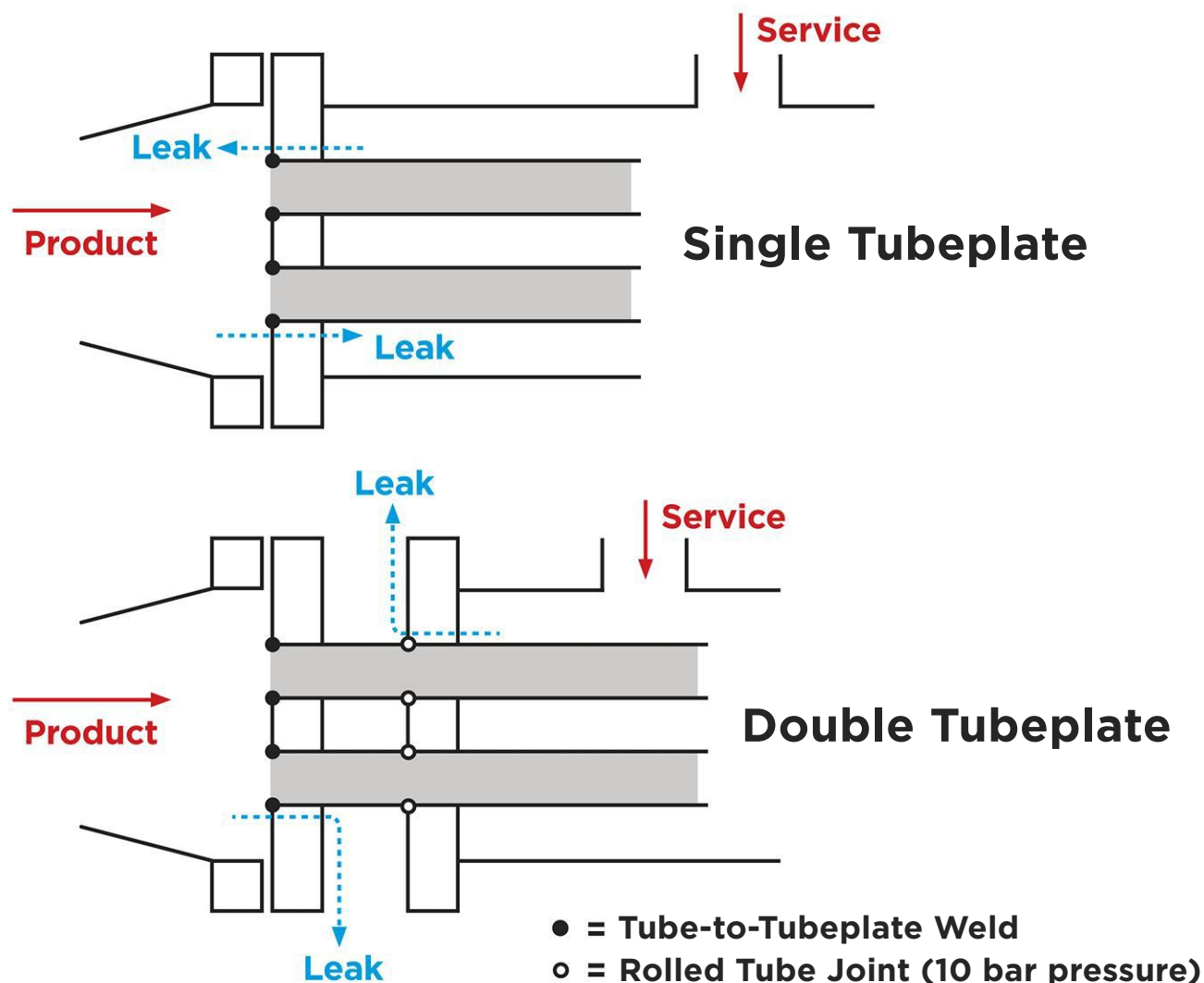
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**FIGURE 1.** The difference between a single (top) and double (bottom) tubeplate can be seen.

product and the service medium (heating or cooling). Typically, two design methods are used to prevent such cross contamination. The first is to maintain a positive pressure difference between the product and the service fluid so that, should a leak occur, the product always will flow into the service fluid rather than vice versa. In order to be successful, however, this pressure differential must be maintained at all times,

and appropriate sensors and monitoring systems must be included in the heat exchanger. Such an approach also adds a level of complication when designing the operating pressures for the equipment.

The second option is to introduce a physical separation between two different tubeplates: one for the product and one for the service fluid (figure 1). This means that in the event of a leak in the tube joints



— from either the service fluid or the product — the material flows into a safety container or other vessel. No mixing of the two materials is possible. Because this option relies on a physical barrier, additional systems are not required, simplifying construction, operation and maintenance of the heat exchanger.

The gap between the two tubeplates will depend on a number of factors, including the food products being processed and the space available for the installation. Such a design can be effective even when the distance is just 0.12" (3 mm). Depending on the materials being used and the type of application in which the heat exchanger is used, the gap between the two plates may be shrouded (with appropriate drain or inspection ports) or open. This gap, and the use of appropriate inspection methods, also means that double tubeplates make it easier to spot when such failures or leaks occur, allowing appropriate repairs and maintenance to be carried out rapidly.

For these reasons, the double tubeplate system can be used in food production applications

where contamination needs to be prevented. With some manufacturers, double tubeplates are included as standard with multi-tube heat exchangers.

Similar considerations also are paramount when dealing with pharmaceutical products, and double tubeplates may be standard on exchangers for use in pharma applications.

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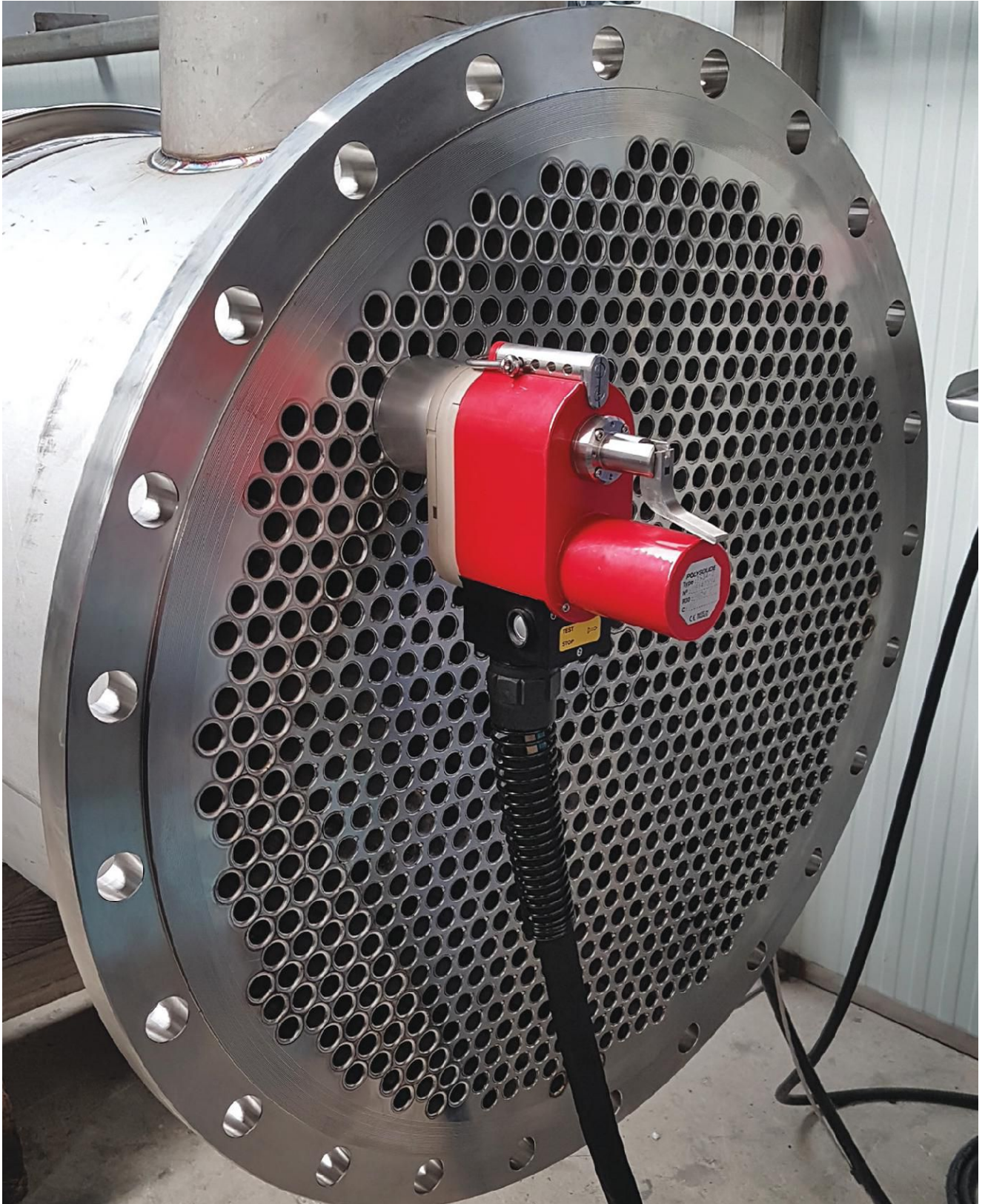


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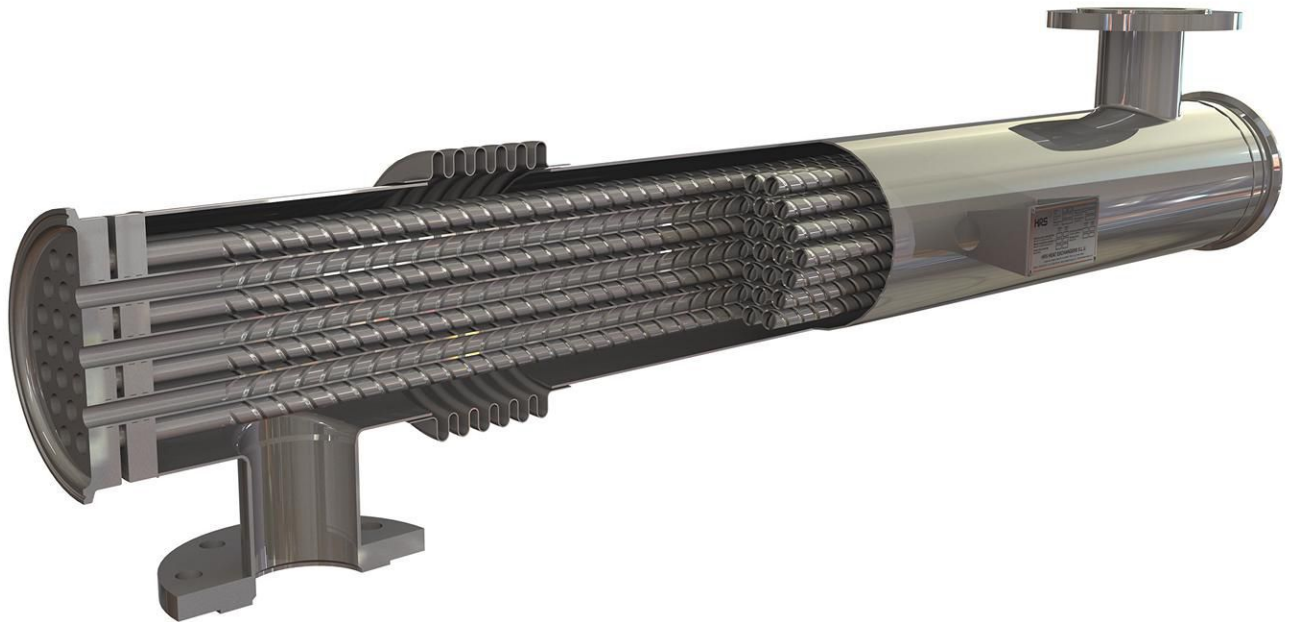
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The tubesheet (or tubeplate) is the point at which the tubes in the heat exchanger are welded to the end of the vessel.



With a double tubeplate, the service fluid is contained by a separate plate from the one to which the product tubes are welded.

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### Multinational Food Producer Reaps Benefits of Corrugated Heat Exchanger

A food ingredients plant in the northern Malaysian province of Seberang Perai wanted to replace an existing smooth-tube heat exchanger on a line producing powdered food emulsifier.

The facility, owned by a multinational food producer and located in the Malaysian state of Penang, had long used smooth-tube heat exchangers for cooling, heating and condensation. Despite reservations about switching to corrugated-tube exchangers, the food processor opted for the corrugated units to increase energy efficiency, reduce maintenance and cleaning requirements, and lower operational costs.

The corrugated tube creates turbulence to break down fouling layers as they form. This reduces cleaning requirements — one of the food processor's main considerations. The supplied heat exchanger uses steam to heat 2866 lb/hr of fatty acid esters and was designed to withstand up to 725 psi of steam pressure. It is configured as a TEMA BEU-type — with a removable tube bundle in a U-configuration — to assist cleaning and maintenance. The smooth-tube exchanger it replaced was a BEM type with fixed tubes, which contributed to cleaning challenges.

The stainless steel shell-and-tube heat exchanger is suited for steam-to-water applications and where materials have low-to-medium viscosities. The product flows through the interior tubes and the service fluid flows through the surrounding shell. The corrugation technology improves heat transfer and efficiency vs. smooth-tube heat exchangers. In addition, effects of fouling are minimized.

Expansion bellows are fitted to absorb the differential expansion between the shell and the inner tubes.

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**Leakage in tubular heat exchangers often leads to cross contamination between the product and the service medium (heating or cooling).**

## Preventing Contamination, Performing Maintenance

Attention also needs to be given to the potential contamination of (and from) environmental factors used in the production and processing of products. These include water and air used for process heating, cooling or sterilization. Obviously, the best option is to prevent contamination in the first place, and many regulations are in place that enforce this. For example, pharmaceutical, cosmetic and medical ingredients often have tight temperature tolerances, requiring specific operations to be carried out at specific temperatures. Applications

such as the production of purified water and water for injection (WFI) require the highest standards of hygiene.

Finally, it is important to regularly clean, inspect and maintain heat exchanger equipment in line with the manufacturer's recommendations. For example, when handling acidic or abrasive materials such as fruit juice, more frequent inspection and cleaning may be required. Regular cleaning will ensure that drain holes and the like operate correctly in the event of a leak. Maintenance and cleaning also will reduce the risk of leaks occurring and provide an opportunity for any repairs. **PC**

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